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SYNERGY

BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY

UNDERSTANDING INTELLIGENT BEHAVIOR The newest research theme at the Beckman Institute, Intelligent Systems, was created by merging two themes. It "seeks to understand intelligent behavior in biological and artificial systems and their networked interactions, including the nature of plasticity and adaptation in these systems, and to use that understanding to advance science and technology, to promote the health and well-being of individuals and communities, and to benefit society." See page 2.

New Research Theme Seeks to Understand Intelligent Behavior

By Lizzie Porter

Since the Beckman Institute for Advanced Science and Technology opened its doors in 1989, a core objective has been to be a leader in science and technology by continually fostering new research areas and developing new methodologies. Intelligent Systems is a new major research theme organized to do just that.

Merging themes

The former themes, Biological Intelligence (BioIntel) and Human-Computer Intelligent Interaction (HCII), have merged into the new theme, which is co-chaired by Liz Stine-Morrow and Kara Federmeier.

According to the mission statement, Intelligent Systems "seeks to understand intelligent behavior in biological and artificial systems and their networked interactions, including the nature of plasticity and adaptation in these systems, and to use that understanding to advance science and technology, to promote the health and well-being of individuals and communities, and to benefit society."

For many years, it was clear that the groups within the two themes were very closely connected. A number of collaborative research projects, such as work on health care portals for the elderly and language development in children, have relied on the expertise of members of both BioIntel and HCII.

"The new structure better reflects the work that is actually done at Beckman, and creates formal lines of communication that weren't there before," Stine-Morrow said.

Changing landscape

"Beckman exists to be an incubator of groundbreaking interdisciplinary research. This requires nimble response to the changing landscape of discovery and emergence of grand challenges," said Federmeier and Stine-Morrow, when explaining the new theme at a presentation. The yearlong process of creating the new research theme was based in part on faculty collaboration as well as the input of an external advisory committee review, which examined both BioIntel

Intelligent Systems Groups

- Cellular and Molecular Foundations of Intelligent Behavior (CaMF), led by Dan Llano
- Cognition, Lifespan Engagement, Aging, and Resilience (CLEAR), led by Liz Stine-Morrow
- Illinois Language and Literacy Initiative (ILLI), led by Kara Federmeier and Kiel Christianson
- Intelligence, Learning, and Plasticity (ILP), led by Aron Barbey
- Mechanisms of Cognitive Control (MoCC), led by Diane Beck
- Neurotechnology for Memory and Cognition (NMC), led by Jonathan Sweedler and Martha Gilette
- Organizational Intelligence and Computational Social Science (OrgInt), led by Mark Hasegawa-Johnson
- Social and Emotional Dimensions of Well-being (SEW), led by Florin Dolcos

Frini Karayanidis

Senior Fellow Examines How Cognitive Control Varies With Age

By Ryan Rodgers

An associate professor of psychology from the University of Newcastle in Australia, Frini Karayanidis is collaborating with Gabriele Gratton and Monica Fabiani of the Mechanisms of Cognitive Control Group to look at how cognitive control varies as we age.

In 2001, Karayanidis met Gratton and Fabiani during a workshop on optical imaging at Newcastle. Since then, the three have become not only colleagues, but also friends, meeting again in 2014 at a conference in Brisbane, Australia, as well as several conferences in the United States and Europe.

Recently Karayanidis traveled to the Beckman Institute for an extended stay as a Beckman Senior Fellow. The trio worked on a special issue of the journal *Psychophysiology* that focuses on the dynamics of cognitive control, using a variety of neuroimaging methods and experimental paradigms. The issue includes a number of authors and is expected to be published in 2017.


Kara Federmeier


Liz Stine-Morrow

Two research themes, Biological Intelligence and Human-Computer Intelligent Interaction, have merged into the new theme, Intelligent Systems, which is co-chaired by Kara Federmeier, far left, and Liz Stine-Morrow.

and HCII as the plans were developing for the combined theme.

"Reorganization of the themes that were formerly called BioIntel and HCII into the new Intelligent Systems was an engaging process," said Jeff Moore, interim director of the Beckman Institute.

"The teams are now highly interdisciplinary but tightly interconnected, poised to advance the most pressing questions, from molecular mechanisms of intelligent behavior to the role of social interactions on well-being," Moore said.

Stine-Morrow and Federmeier hope to create within Intelligent Systems the infrastructure that affords a dynamic response to new and unexpected challenges in science and technology, while also assuring that the research groups have the stability and resources needed to develop and thrive. Within the theme, each faculty member is part of a primary group, but can choose to be a part of any number of groups. Faculty members also have the option of creating new groups within the theme over time through an annual process.

"Our goal in this reorganization is to create problem-focused initiatives that are more reflective of the grand challenges in basic and translational science that we are well-positioned to tackle," Stine-Morrow said.

"We all come from our individual disciplines, but we come to Beckman to bring that disciplinary background to bear on solving particular problems," Stine-Morrow said.

More information on the theme and the research groups can be found online at *beckman.illinois.edu/research/themes/intelligent-systems*.

Karayanidis' research group at Newcastle studies how people efficiently and adaptively apply cognitive control processes to optimize behavior across the lifespan.

"My fundamental area of interest is understanding the complex interplay between neural processes and environmental influences that determine development of cognitive control across the lifespan," Karayanidis said. Cognitive control refers to adaptive or flexible behavior, including the ability to plan and anticipate, set goals, and adjust those goals as the environment changes.

"In recent years I've become interested in how these abilities vary across different individuals and impact real-life behavior. As our goals and needs change with age, variability in cognitive control affects us in different ways. And that's why I'm examining different age groups."

In a recent presentation that she gave at the Beckman Institute, Karayanidis illustrated this point using an example from road accident statistics which show that both young adults (under 25 years) and older adults (over 70 years) are overrepresented in fatal traffic accidents.

While cognitive control failures are at the heart of many of these traffic accidents, the underlying cognitive control processes differ in the two age groups. In young drivers, fatal accidents often result from failure to flexibly reduce driving speed under treacherous conditions, whereas the accidents caused by older adults are frequently due to difficulty making timely decisions in complicated traffic situations.

Karayanidis' research tests recent neurobiological models of adolescent risk-taking behavior. These models propose that increased risk-taking in adolescence results from an imbalance in the rate of maturation of subcortical reward networks and frontal cognitive control networks. This makes teens and older adolescents much more prone to reward-driven behaviors. Although often they can accurately identify the risks,

continued on page 4

Cognitive Control, from page 3

they have greater difficulty abstaining from risky behaviors that are associated with social rewards. When asked why, teens will often report "it seemed worth it at the time."

This strong interplay between the engagement of cognitive control and the disruptive effects of immediate short-term rewards is not restricted to children or teens. Karayanidis suggests that the distractive effect of cellphones or email notifications that most of us experience on a daily basis is one example of how immediate rewards can disrupt effortful cognitive ability in the young and in older adults alike.

In Australia, Karayanidis heads the Functional Neuroimaging Laboratory, which uses a range of imaging tools such as structural and functional magnetic resonance imaging (fMRI), electroencephalogram (EEG) and event-related potential (ERP) analyses as well as formal cognitive models to study cognitive control processes.

Her Beckman visit has inspired a new collaboration with Gratton and Fabiani in the Cognitive Neuroimaging Laboratory. They intend to extend Gratton and Fabiani's work with optical pulse imaging in healthy aging to examine the role of arterial elasticity on white matter health and associated cognitive control in patients who have had a mini-stroke.

This work will be conducted within the University of Newcastle's Priority Research Centre for Stroke and Brain Injury, where Karayanidis heads the Psychological Processes Platform. This project will pioneer the use of event-related optical signals (EROS), a specialty of Fabiani and Gratton, and other optical technologies in studying stroke recovery and rehabilitation, enabling further collaborations between researchers in the United States and Australia.

Lee Develops Method for Synthesizing Conjugated Nanohoops

By Maeve Reilly

He's not building replicas of a Star Wars airship or of the Taj Mahal, but Semin Lee compares the molecules he builds with to how a child plays with Legos.

"Just as I played with Legos as a kid, I enjoy playing around with molecular building blocks to make new structures on my computer," Lee said. "This hobby is useful when the molecules have functional applications and becomes even more interesting when they are easy to synthesize."

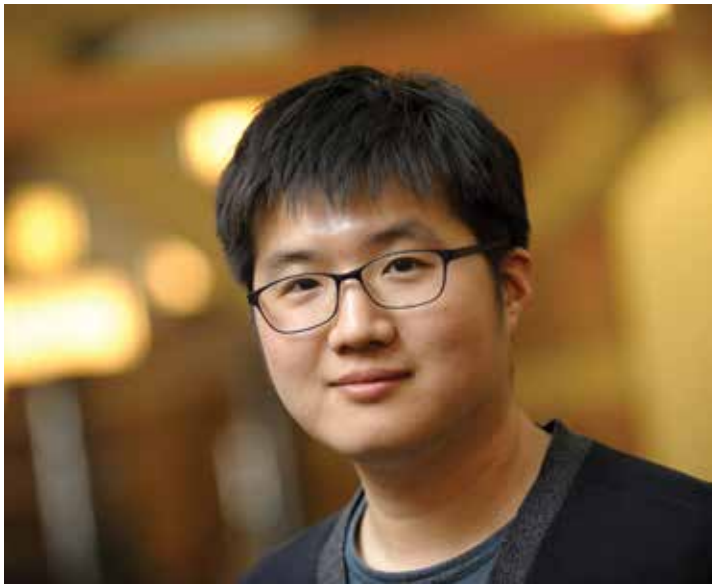
New method

A Beckman Postdoctoral Fellow since 2014, Lee works primarily with Jeff Moore, a professor of chemistry and a member of the Autonomous Materials Systems Group. A recent paper, with Lee as first author, outlined a method Lee designed for synthesizing conjugated nanohoops, which are reminiscent of the shortest segment of a carbon nanotube. That paper, "Synthesis of Cycloparaphenyleneacetylene via Alkyne Metathesis: C_{70} Complexation and Copper-Free Triple Click Reaction," was published in the *Journal of the American Chemical Society* (pubs.acs.org/doi/abs/10.1021/jacs.6b08752).

> ***"The scientific advance behind Lee's work is significant. We are developing shape persistent scaffolding able to place reactive groups precisely in space on nanometer scale distances. The work is relevant to this year's Nobel Prize in chemistry on molecular machines, but in the future may also be important for precise spatial positioning of biology's macromolecules."***
>
> —Jeff Moore

Carbon nanotubes are incredibly useful structures because they are 100 times stronger than steel, but only one-sixth as heavy. Nanotube fibers can be used to strengthen almost any material. They also conduct heat and electricity better than copper, a commonly used conductor.

"If you cut carbon nanotubes, you get rings of cycloparaphenylenes—they are all linearly connected and can bend to



Beckman Postdoctoral Fellow Semin Lee

A Beckman Postdoctoral Fellow since 2014, Semin Lee, left, works primarily with Jeff Moore, a professor of chemistry and a member of the Autonomous Materials Systems Group.

form a large hoop," Lee said. "Despite the recent breakthroughs in preparing these once impossible-to-make compounds, their syntheses are still bottlenecked by the low-yielding ring formation step."

Lee used dynamic covalent chemistry to overcome this bottleneck. This synthetic technique allows individual building blocks to assemble and disassemble until the stable cyclic structure is reached. Lee plans to apply the nanohoops to organic electronics, such as flexible electronic materials.

Significant advance

"The scientific advance behind Lee's work is significant," Moore said. "We are developing shape persistent scaffolding able to place reactive groups precisely in space on nanometer scale distances. The work is relevant to this year's Nobel Prize in chemistry on molecular machines, but in the future may also be important for precise spatial positioning of biology's macromolecules."

One other crucial development is that the three triple bonds within the nanohoop undergo copper-free click reactions three times.

"People avoid copper because it's toxic," says Lee. "We'd like to move these into biological studies, so copper-free reactions will enable that."

Lee believes that his technique for copper-free triple-click reactions, which are very fast and don't leave any deleterious residue, will enable bioengineers to connect three biomolecules all at once and incorporate nanopores into biological processes at the same time. But there are some obstacles to overcome, primarily creating more stable rings that are compatible with biological media.

"Right now, the compound is very unstable, and the three triple bonds are very reactive," Lee said. "The only thing that can stabilize it right now is to have C_{70} inside, but C_{70} is very expensive."

"We're also currently trying to develop other cheaper guest molecules that can stabilize this compound. In addition, larger rings are hypothesized to be more stable but still be able to do this kind of copper-free click reaction."

A native of Korea, Lee earned his Ph.D. in chemistry from Indiana University and also received the University Graduate School Distinguished Dissertation Award for 2016, the highest honor for research that Indiana University bestows upon its graduate students.

Patrick Innovating Structural Composites

By Ryan Rodgers

Jason Patrick, a Beckman Postdoctoral Fellow, focuses on developing adaptive composite materials.

"I am working to develop a new platform of smart composites through strategic coupling of self-sensing (receptor) capabilities with self-regulating (effector) capabilities to engender active material control," Patrick said.

These multifunctional, synthetic materials can achieve an array of behaviors that are found in nature, such as the ability to heal themselves, much like a cut heals on its own, or regulate temperature, just as humans and animals do. Making the composites "smart" involves giving them the ability to sense changes as well as regulate. For example, instead of a damaged plane wing simply self-repairing, which is a feat in itself, the flight-critical component would also actively monitor its structural status for enhanced safety, reliability, and, ultimately, to improve its overall performance.

Patrick studied civil engineering at North Carolina State University, receiving his master's degree with a thesis entitled "Fundamental Characteristics of 3D Glass Fiber-reinforced Composite Sandwich Panels." He earned his Ph.D. in structural engineering at the University of Illinois for his dissertation "Bioinspired Microvascular Self-healing in Polymers and Composites."

Patrick's doctoral research focused on the advancement of fiber-composite materials, specifically trying to reproduce biological qualities found in nature.

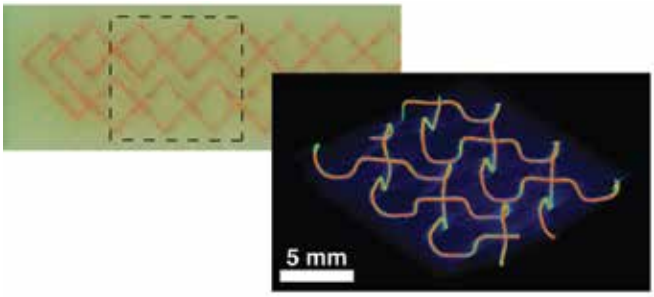
"I created microvascular networks, akin to blood vessels in animals, to circulate functional fluids throughout polymeric materials in order to achieve self-healing of fracture damage," he said. When fracture occurs in these materials, the "vasculature" ruptures, filling the damaged area with liquids that chemically react and "heal" the crack.

> ***"The ultimate goal is to produce a biomimetic structural system that can not only sense its surroundings but also, through active feedback, repair, adapt, and regulate itself accordingly."***
>
> —Jason Patrick

The idea of a vascular network was not new, however, Patrick, working in the Autonomous Materials Systems (AMS) labs, helped develop a technique ideally suited for fiber-composites using conventional processing practices, which has proven more successful than others in terms of vascular complexity and repeated repair.

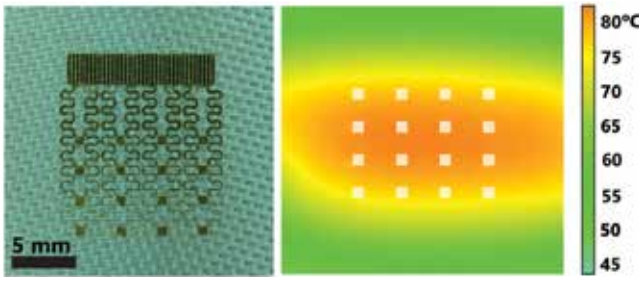
MULTIFUNCTIONAL COMPOSITES

Microvasculature for self-regulation



3D "interpenetrating" microvascular networks: The left image shows interwoven sacrificial fibers within a structural fiber-reinforced composite. At right, a vascular network created by thermal depolymerization of the sacrificial fibers for in situ *delivery of two-part reactive liquid agents to achieve self-healing of internal fracture damage.*

Microelectronics for self-sensing



A multiplexed array of micro-electronic sensors: At left, the device is adhered to a glass-reinforcing textile that is used to fabricate fiber-composites. On the right, an infrared (IR) image of a heated fiber-composite containing an internal sensor array that can accurately determine spatial distribution of temperature (and mechanical strain) through in situ *electrical resistance measurements.*

Beckman Postdoctoral Fellow Jason Patrick focuses on developing adaptive composite materials. Making the composites "smart" involves giving them the ability to sense changes as well as self-regulate.

"By devising 3D, complex microvascular network architectures and dynamically delivering reactive liquid chemicals, we achieved greater than 100 percent recovery in fracture resistance for composite laminates over multiple damage-healing cycles," Patrick said.

These high-performance fiber-composites are used to make components for many automobiles, aircraft, and naval vessels.

The microvascular networks, Patrick discovered, are also capable of modulating other physical properties, for example, temperature and electromagnetic waves.

"In addition to a novel healing platform, the embedded vasculature also enabled multiphysics capabilities, including thermal regulation and electromagnetic modulation via simple fluid substitution," Patrick explained.

Refining the multifunctional capabilities and self-healing performance has become Patrick's focus as a Beckman Postdoctoral Fellow. Working in the AMS laboratories, using the Imaging Technology Group's Microscopy Suite for data collection, and the Visualization Lab's high-throughput computation capabilities that he helped develop, Patrick is researching sensory enhancements to the composite materials he studies, allowing for precise control over the regulating capabilities.

To create and implement the sensory elements, Patrick works with colleagues at the University of Illinois, as well as John Rogers, who is now at Northwestern University but maintains an affiliation with Beckman's 3D Micro- and Nanosystems Group.

"In collaboration with the Rogers group, I have begun to incorporate microelectronic devices within hierarchical, composite laminates to achieve self-sensing and structural health monitoring," said Patrick.

"The latest test results have shown these electronic device arrays can be employed as both thermal and mechanical strain sensors and also thermal actuators with low-power requirements," he said.

With simple measurements of electrical resistance changes, the amount of stretch or shrinkage (strain) within fiber composites can be determined over the area a device spans. By applying an electrical voltage across the device, the composite can be heated, for instance, to aid in healing or to expand operating environments, Patrick said.

Through other strategic integrations of sensory components and regulating functions, Patrick is honing in on creating materials capable of monitoring themselves and modifying their structure to adapt to varying conditions.

"The ultimate goal is to produce a biomimetic structural system that can not only sense its surroundings, but also, through active feedback, repair, adapt and regulate itself accordingly," Patrick said.

In order to increase the accessibility of his composite materials, Patrick continues to streamline manufacturing processes.

"I am adapting state-of-the-art manufacturing and fabrication techniques, for example, 3D printing, in order to make such multifunctional systems commercially viable for real-world applications," Patrick said. "Hopefully one day in the near future, none of us will worry if our car gets dinged in the parking lot as it will 'self-heal' and send a message to our smartphone letting us know it's been fixed, and for free."

Beckman Postdoc Examamines the Effects of Alcohol Consumption During Pregnancy

By Ryan Rodgers

"According to a recent Centers for Disease Control and Prevention report, 1 in 10 pregnant women admit to any alcohol use and 1 in 33 report to binge drinking," said Gillian Hamilton, a Beckman Postdoctoral Fellow. Hamilton focuses her research on how alcohol consumption during pregnancy affects the developing fetus.

Recently, Hamilton was awarded a National Institutes of Health Ruth L. Kirschstein Postdoctoral Individual National Research Service Award to fund further research. The fellowship allows postdoctoral researchers to extend their potential for research in specified health-related areas.

With her research, Hamilton hopes to "further elucidate exactly how developmental alcohol exposure impacts the developing brain, resulting in lifelong damage."

The hippocampus is heavily involved in memory and learning, while the prefrontal cortex serves a crucial role in behavioral inhibition. Damage incurred during development of these areas of the brain can have far-reaching implications into adulthood. Hamilton believes that expanding understanding of how these areas are affected is a key step in educating the public.

Her past work specifically focused on the effects of binge drinking. Her most recent publication, "Behavioral deficits induced by third-trimester equivalent alcohol exposure in male C57BL/6J mice are not associated with reduced adult hippocampal neurogenesis but are still rescued with voluntary exercise," was featured in the November 2016 issue of *Behavioral Brain Research.* It looks at this topic through a study that examined long-term influences on the hippocampus and prefrontal cortex development of either a single or repeated alcohol exposure during the third-trimester equivalent.

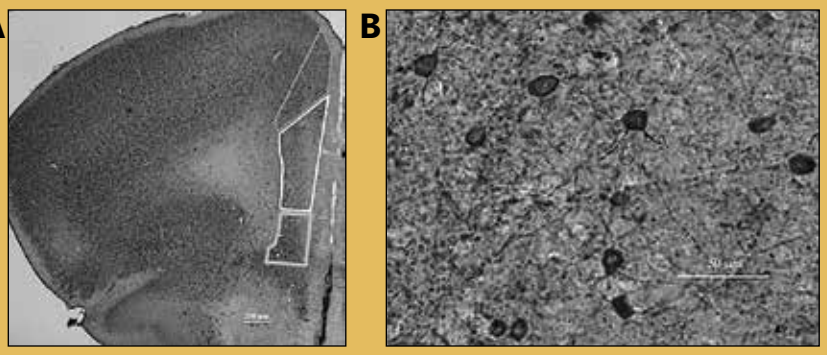
"Some pregnant women believe that during the third trimester, much of the baby's body is already formed and therefore drinking alcohol will be less detrimental," Hamilton said. "However, during the third trimester there is a period of mass neurodevelopment where a brain growth spurt occurs. Therefore, late developing brain regions such as the hippocampus and prefrontal cortex are especially sensitive to third-trimester alcohol exposure."

In her research, Hamilton and colleagues studied these influences using mouse models, introducing alcohol postnatally in the equivalent of the third trimester of development.

"Some pregnant women believe that during the third trimester, much of the baby's body is already formed and, therefore, drinking alcohol will be less detrimental. However, it is during the third trimester that is a period of mass neurodevelopment where a brain growth spurt occurs. Therefore late developing brain regions such as the hippocampus and prefrontal cortex are especially sensitive to third-trimester alcohol exposure."

—Gillian Hamilton

Once the alcohol-exposed mice and a control group of mice matured, groups of each were provided exercise wheels to study how exercise affected their performance on passive avoidance and motor skill tests.



Work done in the Microscopy Suite is shown. Side A shows the outlines of various subregions of the prefrontal cortex of the brain that were analyzed and Side B is magnified to show cells that were being counted.

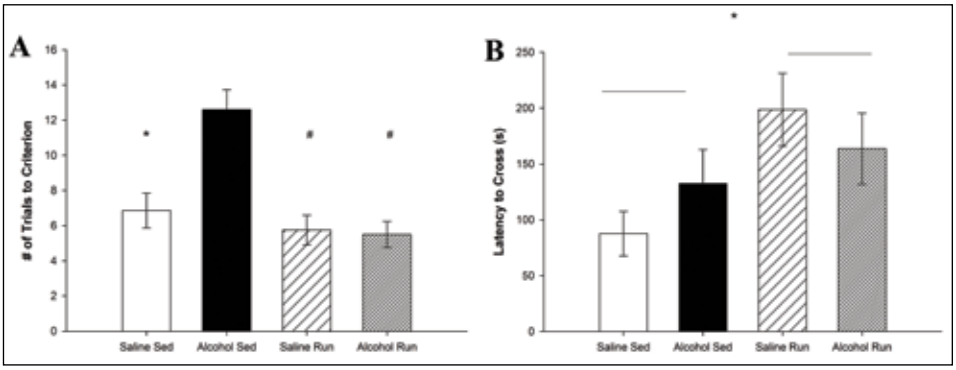
Beckman Postdoctoral Fellow Gillian Hamilton studies the effects of alcohol during pregnancy, the impacts on the child, and how these effects may be combatted.

In a passive avoidance task, the alcohol-exposed mice took longer to learn the task, but ultimately were capable of performing it. Additionally, mice that were exposed to alcohol and also exercised, learned the task more quickly than mice that were exposed to alcohol and did not exercise.

Hamilton noted that since, "alcohol-exposed animals required significantly more trials to learn the passive avoidance task, [it suggests] this [is] a learning deficit and not a motor deficit."

Following the trials, key instruments in the Microscopy Suite were utilized to examine and calculate cell density and health within various parts of the brain that were exposed to amounts of alcohol similar to what would be considered binge drinking.

Because the alcohol-exposed mice that exercised regularly were able to learn the task more quickly than the non-exercising alcohol-exposed mice, Hamilton has concluded that exercise could serve as a therapeutic option for mitigating motor- and cognitive-related deficiencies caused by fetal alcohol exposure. However, more research needs to be completed to address other complications of exposure to alcohol in the womb.



The graphs depict the passive avoidance data mentioned in the article. Graph A shows that alcohol-exposed animals require significantly more trials to acquire the task; however, this deficit is no longer present if the mice are given access to a running wheel. Graph B shows that when tested the following day on task retention there is no longer any alcohol-induced deficit, but all animals given access to a running wheel have better performance.

Hamilton's current research focus is on more moderate alcohol consumption and her interest stems from the frequency with which it occurs.

A present focus is in collaboration with Justin Rhodes in the Cellular and Molecular Foundations of Intelligent Behavior Group at Beckman.

"Using a 'Drinking in the Dark' model of alcohol exposure, developed by Dr. Rhodes, the pregnant mice are either given access to alcohol or tap water for four hours each day throughout their pregnancy," explains Hamilton.

For those mice that drink the alcohol, the concentration is similar to what humans experience in "just over the legal limit."

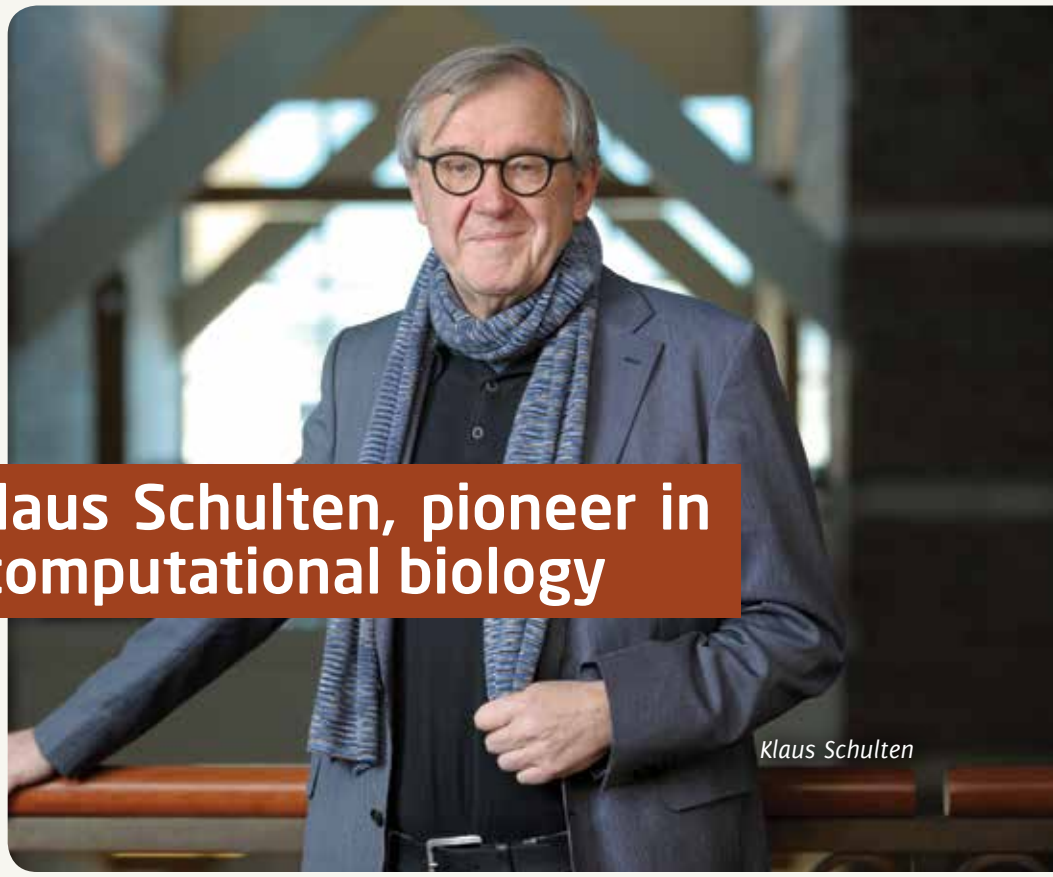
"Once their pups are born, I am interested in investigating how this alcohol exposure impacts brain development," Hamilton said.

Hamilton hopes to further explore other treatment options for fetal alcohol exposure, and to continue to examine the effects of light to moderate alcohol consumption throughout a given pregnancy.

In Memoriam: Klaus Schulten, pioneer in biophysics and computational biology

By Diana Yates

University of Illinois physics professor Klaus Schulten, an innovator in the use of computational methods to study the chemical and biological processes driving living cells, died Monday, Oct. 31, 2016, at Carle Foundation Hospital in Urbana. He was 69.



Klaus Schulten

Schulten was a research powerhouse, leading a team of more than 30 students and postdoctoral scientists in the Theoretical and Computational Biophysics Group, which he founded at the Beckman Institute for Advanced Science and Technology in 1989, the year it opened.

With a background in chemical physics and a keen understanding of the potential of powerful computers to model biological structures and the chemistry that drives them, Schulten led the development of software that allows scientists to observe how molecules behave and interact at the atomic scale. These include VMD, a program for the interactive display, animation, and analysis of large biomolecules, and NAMD, a large-scale molecular dynamics simulation program that incorporates the best available experimental data while accounting for the moment-by-moment chemical interactions of as many as 100 million atoms.

Schulten was among the first scientists to use the Blue Waters supercomputer at the National Center for Supercomputing Applications at Illinois.

"In biology and in biomedicine, we have to realize that basically all organisms are large societies of molecules," Schulten said at the time. "We need a supercomputer to see that society for the first time." He used Blue Waters to develop a "computational microscope" that captures biomolecules in action.

Schulten's group made fundamental contributions to numerous areas of biology, most recently to understanding animal vision, photosynthesis, force generation in cells, membrane channel dynamics, and large-scale cellular organization. He and his colleagues revealed the precise chemical structure of the HIV capsid and contributed to a deeper understanding of the chemistry of odor detection.

"Klaus was one of the most creative, far-sighted and ambitious pioneers of quantitative and computational biology," said physics professor Yann Chemla. "He will be remembered not just for his groundbreaking development of computational approaches to biology, but for the many important biological insights that emerged from these approaches, in fields as wide-ranging as neuroscience and molecular biology."

"The void left by his loss is very significant, not only to our group, but for the scientific community at large," said Beckman Institute postdoctoral researcher Juan Perilla, a member of Schulten's lab. "His contribution to science was immeasurable. He was always seeking to do what no one had ever done before. At the same time, he was extremely generous and shared his achievements with everyone."

Schulten was a Swanlund Professor of Physics, the director of a National Institutes of Health Center for Macromolecular Modeling at Beckman, and a co-director, with Chemla, of the National Science Foundation Center for the Physics of Living Cells at Illinois. He also was affiliated with the Department of Chemistry and the Center for Biophysics and Computational Biology at the U. of I. He trained more than 77 graduate students in physics, biophysics, and chemistry at Illinois.

Schulten was born Jan. 12, 1947, in Recklinghausen, Germany. He graduated from the University of Muenster with a degree in physics in 1969, and obtained a Ph.D. in chemical physics from Harvard University in 1974. He was a professor at the Technical University of Munich before joining the physics department at the U. of I. in 1988.

He is survived by his wife, U. of I. chemistry professor Zan Luthey-Schulten; his daughter, Charlotte Schulten; and a son-in-law, S. Case Bradford.

Symposium Celebrates Career, Research of Thomas Huang

Above: Margaret (left) and Thomas Huang (second from right) are joined by former students and guests from around the world, including (left to right) Kiyoharu Aizawa, from the University of Tokyo; Nicu Sebe, University of Trento; and William Sanders, the head of the Department of Electrical and Computer Engineering at Illinois.

Zhi-Pei Liang, a professor of electrical and computer engineering and a member of the Bioimaging Science and Technology Group, was a member of the program committee, and served as emcee of the Saturday night dinner.

The Huang Symposium on Sept. 30-Oct. 1, 2016, at the Beckman Institute honored Thomas S. Huang, a longtime Beckman faculty member, who has mentored more than 100 students.

Huang, a research professor in electrical and computer engineering, played a significant role in the preliminary building committees at the Beckman Institute, and, when the doors opened in 1989, Huang eagerly moved his lab to Beckman, forming the Image Formation and Processing Group. The symposium featured current and past colleagues discussing Dr. Huang's research and related topics.

At left, Andreas Cangellaris, the dean of the College of Engineering at Illinois, provides remarks at the event about Huang's contributions.

At right, Chang-wen Chen, a professor of computer science and engineering at the University of Buffalo, SUNY, and a member of the program committee, speaks at the dinner in honor of Dr. Huang.

Fenton-Rhodes Lecture Features Stress Expert

The Fenton-Rhodes Lecture on Proactive Wellness featured Robert Sapolsky on Sept. 22 on "Why Zebras Don't Get Ulcers." The science writer, biologist, neuroscientist, and stress expert spoke at Krannert Center for the Performing Arts as the keynote speaker for the Pygmalion Festival.

Robert Sapolsky, a professor of neurology and neurological sciences and neurosurgery at Stanford University, presented a lecture on stress and health.

A discussion period was held after the lecture, which was held at Krannert Center for the Performing Arts as part of the Pygmalion Festival.

From left, Peter Fenton, Robert Sapolsky, and Justin Rhodes at the event. Fenton and Rhodes sponsor the lecture series, which featured their former Stanford professor during its inaugural year.

Beckman-Brown Lecture Features Millennium Prize Winner

On Sept. 19, the Beckman Institute hosted the Annual Beckman-Brown Lecture on Interdisciplinary Science, with Frances H. Arnold, 2016 recipient of the Millennium Prize, speaking on "New Enzymes by Evolution: Expanding the Scope of Biocatalysis." Arnold is the Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry, and the director of the Donna and M. Rosen Bioengineering Center at the California Institute of Technology.

Established by the Arnold and Mabel Beckman Foundation, the lecture honors Theodore "Ted" Brown, the founding director of the Beckman Institute, and Dr. Arnold Beckman, whose gift of $40 million in 1985 provided the funding for the Institute.

Ted Brown with Lydia Kisley, the first recipient of the Beckman-Brown Interdisciplinary Postdoctoral Fellowship. The fellowship was created with funding from the Beckman Foundation and honors Brown, the founding director of the Beckman Institute, and Dr. Arnold Beckman, who provided the initial gift for the Institute.

Frances H. Arnold, the speaker at the inaugural Beckman-Brown Lecture, is from the California Institute of Technology, where her research focuses on protein engineering by directed evolution, with applications in alternative energy, chemicals, and medicine.

Beckman Building Inspires Winning T-shirt Design

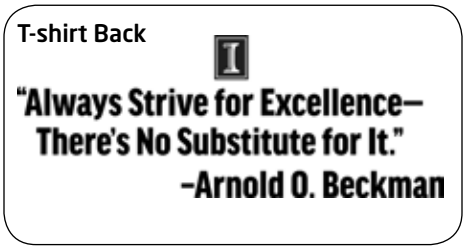
Graphic designer Christie Klinger decided to turn her talents to something a little more whimsical than journal covers and scientific figures when she created the winning T-shirt design for the Beckman Institute Open House.

"I decided to abstract the iconic Beckman building using basic shapes and color for definition," Klinger said about her winning design, which is featured in the campus's traditional orange and blue colors. "I wanted the design to be simple yet striking and identifiable from a distance. Researchers at the Beckman Institute are constantly innovating, and they always have cutting-edge solutions to problems. The design's abstraction represents the unique perspective researchers at Beckman all share."

Although Klinger recently moved to Glenview, Ill., she works remotely as a graphics specialist and designer for the Beckman Institute and the National Center for Supercomputing Applications. In addition to working as a freelance graphic designer, she started as a graphics specialist for the Visualization Lab at the Beckman Institute in September 2015. "It's been a blast!" Klinger said, explaining that she collaborated with the Imaging Technology Group (ITG) and university clients to create journal covers, scientific figures, wayfinding materials, and infographics.

T-shirt Front

T-shirt Back



More recently, she has been working with the ITG team and the Department of Anthropology at Illinois to create cutting-edge augmented reality app content, including project branding and identity, 3D modeling, and advanced renders.

Since the open house is biennial, this will be her first one and she's really excited about attending. "I can't wait to learn more about all the incredible interdisciplinary research taking place here; it will be an amazing learning experience," Klinger said. "And it doesn't hurt that hundreds of volunteers will be sporting my T-shirt design!"

Honors & Awards

AMS Group Receives IChemE Award


Sottos


Li


Robb


White


Moore

A collaborative research project led by **Nancy Sottos**, the Donald B. Willet Professor of Engineering in the Department of Materials Science and Engineering and a member of the Autonomous Materials Systems (AMS) Group, has won the Oil and Gas Award at the IChemE Global Awards 2016. The winning entry, "Autonomous Detection of Damage in Coatings," is a collaborative research project undertaken by the BP International Centre for Advanced Materials (BP-ICAM), and involved AMS researchers **Wenle Li**; **Maxwell Robb**, a Beckman Postdoctoral Fellow; Sottos; **Scott White**, a professor of aerospace engineering; **Jeff Moore**, a professor of chemistry; and BP mentor Dr. Sai Venkateswaran. The award recognizes the best project or process to demonstrate innovation in the oil and gas sector, efficient energy use or the development of energy production methods that reduce energy intensity.

Bhargava Named Agilent Thought Leader

In January, Agilent Technologies Inc. presented **Rohit Bhargava** with an Agilent Thought Leader Award in recognition of his pioneering work in the development of infrared spectroscopic imaging, and its application to life sciences research.


Bhargava

Bhargava is a Founder Professor of Bioengineering and a member of the Bioimaging Science and Technology Group. He also is the founder and director of the Cancer Community at Illinois program, which will be renamed the Illinois Cancer Center in 2017. The award includes funding and technology from Agilent, which will enable Bhargava to develop new applications and software to facilitate infrared analysis of histological samples, in particular for cancer detection and diagnosis.

IEEE Honors Leburton with Life Membership


Leburton

Jean-Pierre Leburton, the Gregory Stillman Professor of Electrical and Computer Engineering and a member of the Nanoelectronics and Nanomaterials Group, has been selected by the Institute of Electrical and Electronics Engineers for IEEE Life Membership. This honor is awarded to individuals in the association who have exhibited leadership, volunteerism, and dedication to advancing technology for humanity. Life member status recognizes Leburton's outstanding achievements and research that have made a significant impact on the growth and development of IEEE. Leburton is an expert in the theory and stimulation of semiconductor devices and low-dimensional systems.

Ewoldt Named a Presidential Early Career Awardee

Randy Ewoldt, an assistant professor of mechanical science and engineering and a member of the Autonomous Materials Systems Group, was one of 102 scientists and researchers honored by President Obama as recipients of the Presidential


Ewoldt

Early Career Award for Scientists and Engineers (PECASE), the highest honor bestowed by the U. S. Government on science and engineering professionals in the early stages of their independent research careers.

Federmeier Named President-Elect of Society of Psychophysiological Research


Federmeier

Kara Federmeier, a professor of psychology and a member of the Illinois Language and Literacy Initiative, was named the president-elect of the Society of Psychophysiological Research. Founded in 1960, the society fosters research on the interrelationships between the physiological and psychological aspects of behavior.

Jasiuk wins 2016 IAAM Award


Jasiuk

Iwona Jasiuk, a professor of mechanical science and engineering and a member of the 3D Micro- and Nanosystems Group, has been named the recipient of the 2016 American Advanced Materials Award from the International Association of Advanced Materials. She was honored at an awards ceremony at the American Advanced Materials Congress 2016 on Dec. 4. She also presented a lecture titled "Novel copper-carbon nanomaterials."

Honors & Awards, continued on next page

Honors & Awards, from page 13

Lydia Kisley Named to Forbes '30 Under 30'


Kisley

Lydia Kisley, the inaugural Beckman-Brown Fellow, was featured in the Forbes "30 Under 30" List for 2017. The annual list highlights innovators who are under 30 years old and work in a variety of different industries, from media to manufacturing. Kisley was included on the health care list. She works with several researchers on campus including Deborah Leckband, the Reid T. Milner Professor of Chemical Sciences and a member of the 3D Micro-and Nanosystems Group; Martin Gruebele, the James R. Eiszner Chair in Chemistry, the Chemistry Department head, and a member of the Nanoelectronics and Nanomaterials Group; and Paul Braun, the Ivan Racheff Professor of Materials Science and Engineering and a member of the 3D Micro- and Nanosystems Group. With her research, she aims to "inspire and design materials and biomaterials in smarter ways by using unique microscopy in order to understand them better."

Mohaghegh Honored With Professional Women's Achievement Award


Mohaghegh

Zahra Mohaghegh, an assistant professor of nuclear, plasma, and radiological engineering and a member of the Organizational Intelligence and Computational Social Science Group, is the 2016 winner of the American Nuclear Society's Mary Jane Oestmann Professional Women's Achievement Award. Mohaghegh is cited for her leadership, entrepreneurship, substantial multidisciplinary research, and scholarly contributions in the area of probabilistic risk assessment (PRA). She is noted for her pioneering introduction of human and organizational factors in PRA of socio-technical systems in nuclear and other fields.

Beckman Faculty Receive GEBI Endowed Appointments


Bashir


Bhargava


Bresler


Roth

Beckman faculty members were among those named for Grainger Engineering Breakthroughs Initiative (GEBI) endowed appointments. **Rashid Bashir**, a professor of bioengineering and a member of the 3D Micro- and Nanosystems Group, has been named as the first Grainger Distinguished Chair in Engineering. **Rohit Bhargava**, a professor of bioengineering and a member of the Bioimaging Science and Technology Group; **Yoram Bresler**, a professor of electrical and computer engineering and a member of the Organizational Intelligence and Computational Social Science Group; and **Dan Roth**, a professor of computer science and a member of the Illinois Language and Literacy Initiative, also were named as Founder Professors of Engineering.

Pan Wins NML Researcher Award and AHA Award


Pan

Dipanjan Pan, an assistant professor of bioengineering and a member of the Bioimaging Science and Technology Group, is a recipient of the 2016 NML Researcher Award, sponsored by the journal *Nano-Micro Letters* (NML). The award recognizes 15 outstanding researchers whose research fields are nano and micro science, with special consideration for those who have continuously made outstanding contributions to the development of science in the last three years. Pan is an expert in personalized nanomedicine, converging basic science and engineering with medicine.

Pan also was named co-recipient, with Ph.D. student Aaron Schwartz-Duval, of an American Heart Association award for developing a controlled non-seed mediated gold nano-architecture with supreme branching and anisotropic behavior. The preliminary work was published in *Nano Research*. It is the first time the team demonstrated that supreme hyper-branching is possible even with inorganic nanocrystals and polymer hybrids.

Beckman Faculty Members Named University Scholars


Carney


Chasiotis


Stumpf

Scott Carney, a professor of electrical and computer engineering and a member of the Bioimaging Science and Technology Group; **Ioannis Chasiotis**, a professor of aerospace engineering and a member of the Autonomous Materials Systems Group; and **Rebecca Stumpf**, an associate professor of anthropology and a member of the Bioacoustics Research Laboratory, were named University Scholars. Begun in 1985, the program recognizes excellence in teaching, scholarship, and service on the three University of Illinois campuses and provides $15,000 to each scholar for each of three years to enhance his or her academic career. A total of six Urbana faculty members were honored.

Tajkhorshid Receives NIH Director's Transformative Research Award


Tajkhorshid

Emad Tajkhorshid, a professor of biochemistry and a member of the Theoretical and Computational Biophysics Group, and colleagues Chad Rienstra, a professor of chemistry, and James Morrissey, a professor of biochemistry, received a Director's Transformative Research Award from the National Institutes of Health (NIH) for their highly creative approach to the study of cell membrane lipids. The

High-Risk, High-Reward Research (HRHR) program, supported by the NIH's Common Fund, awarded 12 transformative research awards funded by the director's office.

Suslick Named a Fellow of the National Academy of Inventors


Suslick

Kenneth S. Suslick, a professor of chemistry and a member of the Bioimaging Science and Technology Group, has been nationally recognized for demonstrating a "prolific spirit of innovation." Suslick, the Marvin T. Schmidt Professor of Chemistry and a professor of materials science and engineering, has been named a Fellow of the National Academy of Inventors (NAI). The academy is a nonprofit member organization formed in 2010 to heighten awareness of academic technology and innovation.

Beckman Faculty Receive Distinguished Promotion Awards


Dilger


Kong


Smaragdis


Stumpf

Ryan Dilger, an associate professor of animal sciences and a member of the Bioimaging Science and Technology Group; **Hyun Joon Kong**, an associate professor of chemical and biomolecular engineering and a member of the Bioimaging Science and Technology Group; **Paris Smaragdis**, an associate professor of computer science and a member of the Illinois Language and Literacy Initiative; and **Rebecca Stumpf**, a professor of anthropology and a member of the Bioacoustics Research Lab, received the 2016 Distinguished Promotion Award from the University of Illinois.

Ostoja-Starzewski Elected Fellow of Society of Engineering Science


Ostoja-Starzewski

Martin Ostoja-Starzewski, a professor of mechanical science and engineering and a member of the Bioimaging Science and Technology Group, has been elected a Fellow of the Society of Engineering Science.

White named SES Fellow


White

Scott R. White, a professor of aerospace engineering and a member of the Autonomous Materials Systems Group, has been selected as a Fellow of the International Society of Engineering Science. SES promotes engineering science by bringing together leading engineers, scientists, and mathematicians worldwide to tackle some of the most challenging problems at the disciplines' interface. White, a Willett Professor in the College of Engineering and the director of the recently created Center of Excellence in Self-healing, Regeneration, and Structural Remodeling, has gained international recognition for his work in autonomous materials.

Cheng, Cunningham Elected AAAS Fellows

Beckman faculty members **Jianjun Cheng** and **Brian T. Cunningham** are among six Illinois faculty members elected 2016 Fellows of the American Association for the Advancement of Science, chosen for their efforts to advance science applications that are deemed scientifically or socially distinguished.


Cheng

Cheng, the Hans Thurnauer Professor of Materials Science and Engineering, who is in the Bioimaging Science and Technology Group, was recognized "for the discovery, development and clinical translation of nanomedicines and biomaterials, especially for targeted cancer therapies."


Cunningham

Cunningham, a professor of electrical and computer engineering and of bioengineering, the director of the Micro and Nanotechnology Laboratory, and a member of the Nanoelectronics and Nanomaterials Group, was honored for "exceptional contributions to the advancement of photonic crystal-based biosensing."

Beckman Researchers Named to Highly Cited Researchers List

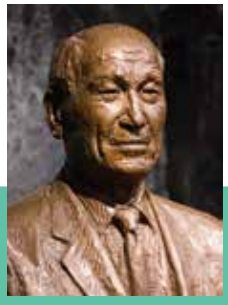

Lu


Murphy


Rogers

Beckman Institute researchers have been named to the Clarivate Analytics Highly Cited Researchers list for 2016 (previously known as the Thomson Reuters Highly Cited Researchers list). **Yi Lu**, a professor of chemistry and in the 3D Micro- and Nanosystems Group, was highly cited in chemistry; **Catherine Murphy**, a professor of chemistry and member of the Nanoelectronics and Nanomaterials Group, was also highly cited in chemistry. **John Rogers**, former Illinois materials science and engineering professor, now at Northwestern University, also is on the list in physics and materials science. Rogers is in the 3D Micro- and Nanosystems Group. The list identifies scientists "whose research has had significant global impact within their respective fields of study," according to a statement from Clarivate Analytics. The list is based on an analysis of journal article publication and citation data, an objective measure of a researcher's influence over the past 11 years.

Photo by L. Brian Stauffer



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